

## ABSTRACT OF THE DISCLOSURE

5           The present invention is an apparatus arranged to maximize heat utilization for a hydrocarbon steam reforming process to produce synthesis gas. The apparatus comprises a refractory lined vessel with partition walls that divide the inside of the vessel into (1) a combustion chamber(s) containing one or more burners, and (2) convection chambers used as a means to remove combustion products from the combustion  
10 chamber through one or more openings at the opposite end of the burner end. The combustion chamber contains one or more reformer tubes in which a mixed-feed of hydrocarbon and steam flow co-current with combustion products and receive direct radiant heat from the combustion flame through the tube wall. The convection chambers contain a tube-in-tube device filled with catalyst in the annuli. The mixed-feed in the  
15 annuli flows counter-current with combustion products and the hot product synthesis gas, and thereby substantially lowers the temperature of the combustion and product gases before the gases exit the furnace. High emissivity materials or walls are used inside the convection chambers to enhance the heat transfer from the flue gas to the reformer tubes.

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